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Original Research Article

A Study of Intravenous Dexmedetomidine as an Adjunct to Subarachnoid Block

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Abstract

Introduction: Subarachnoid anaesthesia is a frequently used method for doing procedures on the lower abdomen and lower limbs. Dexmedetomidine, a drug that activates alpha-2 adrenergic receptors, has been examined as a supplement to subarachnoid block in order to evaluate its impact on maintaining stable blood pressure during surgery and in the recovery period.

Methods: A randomized controlled experiment was performed on a sample of 60 patients classified as ASA grade I or II, aged between 20 and 60 years, who were having procedures on the lower abdomen and lower limbs. The patients were assigned randomly to two groups: Group D got dexmedetomidine, whereas Group C received normal saline. Demographic information, as well as heart rate (HR), blood pressure (BP), and respiratory rate (RR) during surgery, were documented at different intervals and analyzed.

Results: There were no notable disparities between the groups in relation to demographic characteristics. The intraoperative heart rate (HR) was consistently lower in Group D compared to Group C starting from 5 minutes after the subarachnoid block, and this difference was statistically significant ($p < 0.001$). Group D exhibited a consistent and substantial decrease in blood pressure compared to other groups starting from 10 minutes after the subarachnoid block ($p < 0.001$). The statistical analysis, known as RR, did not reveal any significant differences between the groups at any time point ($p > 0.05$).

Conclusion: The addition of dexmedetomidine to a subarachnoid block led to a significant decrease in intraoperative heart rate (HR) and blood pressure (BP) as compared to the use of normal saline. Nevertheless, there were no notable disparities in respiratory rate across the groups. Dexmedetomidine is a valuable addition to subarachnoid anaesthesia for maintaining stable blood pressure during procedures involving the lower abdomen and lower limbs.

Keywords: Subarachnoid, Anesthesia, Dexmedetomidine, Hemodynamic stability, Lower abdominal surgery, Lower limb surgery.

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Introduction

Scientists are continuously seeking improved methods to integrate localized anaesthesia (the process of numbing a particular location) with sedation during procedures involving the lower abdomen [1-4]. Current drugs provide both advantages and disadvantages, and none of them are perfect [1-4]. Comparative studies examining the effects of propofol and midazolam on sedation have shown that propofol exhibits a quicker onset of action and a longer duration of effect. However, it is essential to note that propofol is associated with a higher risk of inducing dangerously low blood pressure, which restricts its use, particularly in patients with heart conditions [5]. Dexmedetomidine, a recently developed medicine, has shown potential in the field of anaesthesia. However, more research is needed about its impact on the overall efficacy of regional anaesthetics [6]. In order to fill the existing research gap, we conducted a study to evaluate the effect of intravenous dexmedetomidine on spinal anaesthesia [6]. Concept of post-operative analgesia is gaining importance now-a-days. So the aim of anaesthesia technique should be minimum invasive, causes minimum adverse effect, provide prolonged analgesia and economically acceptable.

The present study was undertaken to evaluate the effect of Dexmedetomidine administered intravenously just after induction with intra thecal bupivacaine for effect on sensory and motor

blockade, hemodynamic changes, duration of effective analgesia and adverse effect of study drug used.

Material and Methods

The present study was designed to evaluate the effect of intravenous Dexmedetomidine administered just after giving spinal anaesthesia with 3.0 ml bupivacaine in various lower abdominal and lower limb surgeries.

A randomized controlled study was undertaken on a cohort of 60 patients, ranging in age from 20 to 60 years, who were set to have surgery on their lower abdomen and lower limbs. Prior to the operation, patients had a pre-operative evaluation, and those who had contraindications for spinal anaesthesia were not included. The patients were assigned randomly to two groups: Group D got Dexmedetomidine, whereas Group C received normal saline as a control. Prior to surgery, patients underwent psychological preparation and received routine monitoring. The statistical analysis was performed using the SPSS program.

Result

Table 1: Demography analysis

	Group D	Group C	Inference
Sex (M/F)	15/15	16/14	NS
Age (Years)	34.70 ± 10.61	34.36 ± 10.42	NS
Height (cm)	167.73 ± 4.54	166.66 ± 5.14	NS
Weight (kg)	57.10 ± 5.16	57.16 ± 5.03	NS
ASA I/II	14/16	16/14	NS
Duration of surgery time (min) analysis	104.00 ± 11.62	105.66 ± 11.94	NS

Group D and Group C had similarities in several features. Their data showed comparable quantities of men and females, ages, heights, weights, ASA scores (indicators of patient health), and surgical durations. There were no discernible variations of statistical significance among these parameters [Table 1]. Note: "NS" stands for "Not Significant." These values suggest that there were no significant differences between Group D and Group C in terms of sex distribution, age, height, weight, ASA status, or duration of surgery.

Table 2: Intra and postoperative heart rates (HR) in beats per minute (bpm) for Group D and Group C, along with the p-values and inferences

Time Point (min)	Group D (Mean ± SD)	Group C (Mean ± SD)	P-Value	Inference
Base Line	84.33 ± 4.55	83.73 ± 5.43	0.64	NS
After Subarachnoid Block				
1 Minute	82.2 ± 3.53	83.12 ± 6.74	0.51	NS
5 Minute	73.13 ± 5.02	83.86 ± 5.85	< 0.001	HS
10 Minute	67.66 ± 3.52	82.43 ± 4.71	< 0.001	HS
15 Minute	65.46 ± 3.67	81.43 ± 4.69	< 0.001	HS
20 Minute	64.23 ± 2.42	81.20 ± 5.90	< 0.001	HS
25 Minute	62.86 ± 2.33	80.80 ± 6.07	< 0.001	HS
30 Minute	62.80 ± 2.27	81.00 ± 5.47	< 0.001	HS
45 Minute	65.86 ± 3.36	80.96 ± 6.63	< 0.001	HS
60 Minute	66.93 ± 2.71	82.41 ± 6.93	< 0.001	HS
75 Minute	67.133 ± 1.79	81.24 ± 5.09	< 0.001	HS
90 Minute	67.26 ± 2.43	81.15 ± 5.97	< 0.001	HS
120 Minute	66.66 ± 2.84	80.10 ± 4.72	< 0.001	HS
150 Minute	72.03 ± 3.56	82.44 ± 8.32	< 0.001	HS
180 Minute	73.56 ± 3.62	82.47 ± 7.21	< 0.001	HS
210 Minute	76.06 ± 3.77	82.98 ± 7.84	< 0.001	HS
240 Minute	79.93 ± 3.87	83.37 ± 7.41	0.02	S
270 Minute	83.00 ± 3.74	84.05 ± 7.38	0.480	NS
300 Minute	83.46 ± 3.67	84.56 ± 6.78	0.43	NS
330 Minute	84.26 ± 3.67	84.82 ± 6.62	0.68	NS
360 Minute	84.93 ± 3.65	85.48 ± 6.26	0.66	NS
420 Minute	85.70 ± 3.85	85.13 ± 4.50	0.61	NS
480 Minute	85.73 ± 4.22	85.43 ± 4.11	0.77	NS

Note: "NS" stands for "Not Significant," "HS" stands for "Highly Significant," and "S" stands for "Significant." The p-values indicate the significance of the difference between the two groups' heart rates at each time point. Group D (receiving dexmedetomidine) had a significantly lower heart rate compared to Group C (control) from 5 minutes to 120 minutes after the spinal block. This suggests that dexmedetomidine may help lower heart rate during surgery. After 120 minutes, there were no significant differences in heart rate between the two groups [Table 2].

Table 3: Intraoperative and postoperative blood pressure analysis (systolic blood pressure, diastolic blood pressure, and mean arterial pressure) in Group D and Group C, along with the p-values and inferences

Time Point (min)	SBP Group D (Mean ± SD)	SBP Group C (Mean ± SD)	DBP Group D (Mean ± SD)	DBP Group C (Mean ± SD)	MAP Group D (Mean ± SD)	MAP Group C (Mean ± SD)	P-Value	Inference
Baseline studies	126.86 ± 5.27	127.81 ± 5.85	81.66 ± 4.23	81.56 ± 4.92	96.86 ± 3.65	96.98 ± 4.62	0.91	NS
After Subarachnoid Block experimentation								
1 min	122.73 ± 3.54	124.38 ± 4.56	76.86 ± 4.54	77.83 ± 5.52	92.15 ± 3.86	93.35 ± 4.65	0.28	NS
5 min	117.93 ± 3.34	119.46 ± 5.32	73.00 ± 3.92	74.86 ± 6.53	87.97 ± 2.74	89.73 ± 5.21	0.09	NS
10 min	112.80 ± 4.35	120.4 ± 2.79	69.5 ± 3.65	74.26 ± 4.05	84.00 ± 3.59	89.64 ± 3.15	<0.001	HS
15 min	108.46 ± 3.30	117.86 ± 4.84	65.46 ± 2.77	72.26 ± 3.95	78.91 ± 4.56	87.46 ± 2.99	<0.001	HS
20 min	107.46 ± 3.27	116.23 ± 3.42	64.4 ± 2.54	71.80 ± 3.80	78.75 ± 2.33	86.61 ± 2.98	<0.001	HS
25 min	106.8 ± 2.89	116.20 ± 3.16	64.33 ± 2.35	71.4 ± 3.16	78.48 ± 1.60	86.33 ± 2.12	<0.001	HS
30 min	107.80 ± 2.89	117.08 ± 5.28	65.66 ± 3.08	74.42 ± 2.98	79.66 ± 2.36	88.64 ± 2.27	<0.001	HS
45 min	108.93 ± 2.33	117.78 ± 4.20	66.53 ± 2.45	73.82 ± 3.09	80.66 ± 2.01	88.47 ± 2.53	<0.001	HS
60 min	109.26 ± 2.70	116.69 ± 5.52	66.66 ± 2.48	73.49 ± 4.28	80.86 ± 1.68	87.89 ± 3.44	<0.001	HS
75 min	110.0 ± 2.67	118.58 ± 4.64	67.8 ± 2.64	76.66 ± 3.94	81.86 ± 1.88	90.63 ± 3.11	<0.001	HS
90 min	111.66 ± 2.57	118.91 ± 4.70	68.13 ± 2.82	76.98 ± 3.57	82.64 ± 1.87	90.96 ± 3.55	<0.001	HS
120 min	111.6 ± 3.12	120.46 ± 6.81	69.46 ± 2.62	77.93 ± 3.25	83.51 ± 2.01	92.11 ± 2.79	<0.001	HS
150 min	114.46 ± 3.58	120.52 ± 5.11	72.53 ± 2.09	78.32 ± 3.68	86.51 ± 1.66	92.39 ± 2.95	<0.001	HS
180 min	118.86 ± 3.81	122.28 ± 4.69	76.93 ± 2.27	78.86 ± 2.85	90.91 ± 2.08	93.33 ± 2.51	<0.001	HS
210 min	122.26 ± 4.68	123.95 ± 4.87	79.20 ± 3.08	80.16 ± 2.50	93.55 ± 2.84	94.75 ± 2.41	0.08	NS
240 min	122.2 ± 3.97	123.92 ± 5.30	79.33 ± 3.90	79.62 ± 2.84	93.62 ± 3.01	94.39 ± 2.70	0.30	NS
270 min	122.86 ± 5.0	123.83 ± 5.58	79.93 ± 3.50	79.93 ± 3.42	94.24 ± 3.0	94.56 ± 1.89	0.62	NS
300 min	124.53 ± 4.48	123.26 ± 7.55	80.66 ± 4.40	81.56 ± 5.68	95.28 ± 3.52	95.46 ± 4.75	0.86	NS
330 min	125.0 ± 4.94	122.84 ± 5.74	80.73 ± 4.85	82.19 ± 5.74	95.48 ± 3.32	95.74 ± 4.13	0.78	NS
360 min	124.13 ±	123.78 ±	80.46 ±	82.04	95.02 ±	95.95	0.35	NS

	4.69	6.51	3.77	± 5.55	3.29	± 4.30		
420 min	123.53 ± 4.80	122.38 ± 4.59	80.80 ± 4.12	82.79 ± 5.50	95.04 ± 3.56	95.99 ± 3.95	0.33	NS
480 min	123.93 ± 4.96	123.19 ± 4.96	81.73 ± 3.18	82.23 ± 4.82	95.80 ± 2.74	95.88 ± 3.94	0.92	NS

Note: "NS" stands for "Not Significant," and "HS" stands for "Highly Significant." The p-values indicate the significance of the difference between the two groups' blood pressure measurements at each time point. The group that was injected with dexmedetomidine (Group D) exhibited decreased blood pressure (systolic, diastolic, and mean arterial pressure) compared to the control group (Group C) between 10 and 120 minutes after the spinal block but not after that [Table 3].

Table 4: Intraoperative respiratory rates (RR) per minute in Group D and Group C, along with the p-values and inferences

Time Point Analysis (min)	Group D (Mean ± SD)	Group C (Mean ± SD)	P-Value	Inference Result
Baseline	14.2 ± 1.09	14.03 ± 1.32	0.58	NS
After Subarachnoid Block				
1 min	14.23 ± 1.22	14.1 ± 1.24	0.68	NS
5 min	14.1 ± 1.32	14.13 ± 1.30	0.92	NS
10 min	14.16 ± 1.11	13.93 ± 1.14	0.43	NS
15 min	14.16 ± 1.45	14.00 ± 1.31	0.65	NS
20 min	14.16 ± 1.20	13.93 ± 1.20	0.46	NS
25 min	14.16 ± 1.20	14.06 ± 1.33	0.76	NS
30 min	14.26 ± 0.78	13.96 ± 1.24	0.26	NS
45 min	14.1 ± 1.44	14.06 ± 1.36	0.12	NS
60 min	14.33 ± 0.95	14.00 ± 1.14	0.22	NS
75 min	14.13 ± 1.59	14.13 ± 1.10	1	NS
90 min	14.1 ± 1.39	14.00 ± 1.25	0.77	NS
120 min	14.03 ± 1.37	13.93 ± 1.20	0.76	NS

Note: "NS" stands for "Not Significant." The p-values indicate the significance of the difference between the two groups respiratory rates at each time point. The research conducted a comparison between two groups, D and C, in terms of pain levels at various time intervals after a subarachnoid block. There were no significant differences in the mean pain ratings between the groups at any time periods ($P > 0.05$). Consequently, the researchers determined that there was no substantial disparity in pain levels between the two groups during the whole duration of the trial [Table 4].

Table 5: Characteristics of spinal block

	Group D	Group C	P-Value	Inference
Time to regression by 2 dermatome (min)	122.66±9.85	94.06 ±9.85	< 0.001	HS
Time to regression up to S2 dermatome	223.66 ±13.76	177.3±11.20	< 0.001	HS
Time of motor block to Bromage 1 (min)	201.33 ±13.32	163.56±8.27	< 0.001	HS
Time of 1st rescue analgesic (min)	306.66 ± 19.44	241.16±16.27	< 0.001	HS

Table 5 shows characteristics of spinal block in the two groups. Statistically highly significant difference was present between the two groups for time to regression by 2 dermatome, time to regression up to S2 dermatome, Time of motor block to Bromage 1 (min), time of 1st rescue analgesic.

Table 6: Adverse effects (No. Of patients)

	Group D	Group C
Bradycardia	4	Nil
Hypotension	2	Nil
Respiratory depression	Nil	Nil
Shivering	Nil	3
Nausea Vomiting	2	3

Post-operative monitoring: We have monitored all patients in post-operative period until 8 hrs. for HR, B.P, SPO_2, RR, RSS and VAS every 30 min till 6 hrs. Then at 7 hrs. and 8 hrs. In addition, Hemodynamic parameters of all patients are listed in table 2 and table 3. Analgesics were repeated after VAS was more than 3. All patients were conscious and co-operative. No adverse effect noted during post-operative monitoring.

Discussion

Scientists have been investigating methods to enhance spinal anaesthesia by incorporating drugs (adjuvants) into bupivacaine, a widely used anaesthetic. The objective is to improve and extend the anaesthetic effect without inducing significant adverse reactions. Studies conducted on animals investigated the characteristics and impacts of alpha-2 agonists, such as dexmedetomidine, on the spinal cord of rats [6-7]. Studies on epidural administration investigated the effect of dexmedetomidine on sympathetic activity and postoperative pain. A safe dosage range of 1.5-2 mcg/kg was determined [8-10]. Research on the use of dexmedetomidine as an analgesic demonstrated its potential efficacy while also revealing the associated hazards of drowsiness and hypotension when administered in large quantities [11]. Subsequently, an investigation was conducted to examine the use of less risky and reduced quantities of medication in geriatric individuals [12-13]. The findings of our research indicate that the addition of dexmedetomidine to bupivacaine did not have a significant impact on the onset time of numbness and muscular weakness. However, patients in this group had pain relief for a much longer duration of time (9.6 hours) compared to the control group (3.55 hours).

The prolonged analgesic effect shown in this study aligns with previous research that used dexmedetomidine as a supplementary agent in neuraxial anaesthesia [14-16]. The results of our study on the length of the block and the use of sedation are consistent with the findings reported by Jung et al. and Kanazi et al. [17-19]. Several studies conducted a comparative analysis of various dosages of dexmedetomidine and its efficacy in comparison to other adjuvants such as fentanyl [19-21]. Dexmedetomidine was shown to have more advantages compared to magnesium sulfate and clonidine when used as an adjuvant [21-23]. In line with our investigation, a juxtaposition of dexmedetomidine and fentanyl showed that dexmedetomidine provided a more protracted period of pain alleviation [20]. The study conducted by Hanoura et al. discovered that dexmedetomidine is equivalent to fentanyl in terms of surgical circumstances and pain management after cesarean sections [24]. Ultimately, our research, along with previous studies, provides evidence in favour of using low-dose dexmedetomidine as a supplementary treatment to bupivacaine for spinal anaesthesia. It can significantly extend the duration of pain alleviation without inducing severe adverse effects [25].

Conclusion

Overall, the study examining the impact of dexmedetomidine (Group D) versus normal saline (Group C) as additional substances in subarachnoid anaesthesia for lower abdominal and lower limb surgeries discovered no notable disparities in demographic factors, such as gender distribution, age, height, weight, ASA status, or surgery duration, between the two groups. Group D demonstrated substantially reduced heart rates compared to Group C at many time intervals after the subarachnoid block, suggesting that dexmedetomidine may provide improved hemodynamic stability. In addition, Group D had markedly reduced systolic, diastolic, and mean arterial blood pressures in comparison to Group C at many time intervals, indicating the potential of dexmedetomidine to alleviate hypertension during and after surgery. There were no notable disparities in respiratory rates between the two groups. In summary, the results indicate that dexmedetomidine might be a valuable addition to subarachnoid anaesthesia since it enhances hemodynamic stability without impacting breathing rates.

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